



**4th International Workshop on Remote Sensing of Vegetation Fluorescence**

**Valencia, Spain  
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**Project Title**

Diurnal and Directional Responses of Chlorophyll Fluorescence and the PRI in a Cornfield

**Abstract Text**

Determining the health and vigor of vegetation using high spectral resolution remote sensing is an important goal which has application to monitoring agriculture and ecosystem productivity and carbon exchange. Two spectral indices used to assess whether vegetation is performing near-optimally or exhibiting symptoms of environmental stress (e.g., drought or nutrient deficiency, non-optimal temperatures, etc.) are the Photochemical Reflectance Index (PRI) and solar-induced red and far-red Chlorophyll Fluorescence (Fs). Both the PRI and Fs capture the dynamics of photoprotection mechanisms within green foliage: the PRI is based on the association of the reflected radiation in the green spectrum with the xanthophyll cycle, whereas Fs measures the emitted radiation in the red and far-red spectrum. Fs was determined from retrievals in the atmospheric oxygen absorption features centered at 688 and 760 nm using a modified Fraunhofer Line Depth (FLD) method. We previously demonstrated diurnal and seasonal PRI differences for sunlit vs. shaded foliage in a conifer forest canopy, as expressed in the hotspot and darkspot of the Bidirectional Reflectance Function (BRF). In a USDA-ARS experimental field site located in Beltsville, MD, USA, measurements were acquired over a corn crop from a nadir view in 2008 with an ASD FieldSpec Pro (Analytical Spectral Devices, Inc., Boulder, CO, USA) to study the behavior of the PRI for sunlit and shaded foliage as captured in reflectance variations associated with the BRF, in a 1 m tall canopy in the vegetative growth stage. Those observations were compared to simulations obtained from two radiative transfer models. Measurements were then acquired to examine whether the PRI and Fs were influenced by view zenith and azimuth geometries at different times of day. Those measurements were made in 2010 with the Ocean Optics USB4000 Miniature Fiber Optic Spectrometer (Ocean Optics Inc., Dunedin, Florida, USA) at several times during the day on multiple days throughout the growing season. We found that the PRI consistently had higher values, indicating lower stress, in the BRF darkspot associated with shaded foliage than in the hotspot associated with sunlit foliage. We also found that Fs exhibited differences associated with sunlit and shaded canopy sectors, which were most pronounced for the red/far-red Fs ratio. Values indicated greater physiological stress in afternoons compared to mornings, and in the early senescent canopy as compared to the vegetative growth stage. BRFs for both the PRI and the red/far-red Fs ratio were bowl-shaped for the full azimuth sweep of the canopy. These two spectral indices (PRI,

Fs ratio) provided complementary information on the photosynthetic function of the corn canopy.

**Topic**

05 dedicated field experiments

**Presentation Type**

Oral

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